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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

May 14 - May 20, 1999

Summary 99-20

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Table of Contents

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EVENTS

1. GOOD PRACTICES IDENTIFIED AFTER FINDING FOREIGN SUBSTANCE IN BREATHING AIR HOSE

On May 5, 1999, at the Oak Ridge Y-12 Site, a millwright purged a breathing air hose he was preparing to connect to his full-face respirator in order to evacuate stale air trapped in the line. The millwright was removing and segmenting contaminated air ducts, which required respiratory protection. During the purge, an estimated one cup of a milky solution discharged from the hose. The millwright immediately exercised his stop-work authority and warned two other co-workers assigned to the same job who were also preparing to don respirators. He also notified his supervisor, who suspended the work pending investigation of the occurrence. Site personnel sequestered the two other breathing air hoses at the work site for inspection and evaluation. The discovery of a foreign substance in any breathing air component signals an imminent safety hazard. However, the investigation of this event identified two good practices that might well be adopted by other DOE sites and facilities that use breathing air. (ORPS Report ORO--LMES-Y12SITE-1999-0025)

Investigators had the liquid analyzed and determined that it was an ester-in-an-aerated-water mixture. They also determined that the three breathing air hoses being used by the millwrights were shipped to the Y-12 Site from a vendor and arrived at the work site without having undergone the site's equipment test and inspection (ET&I) quality assurance process. The ET&I group inspects and tests the hoses, installs unique couplings that connect with the breathing air system, and tags the hoses. Before starting work, the millwrights noticed that the hoses were missing the required tags and sent them back to the ET&I group for testing. The ET&I group tested the breathing air hoses by pressurizing them to 5 psi with nitrogen, submerging them in water, and then increasing the pressure to 250 psi to check for leaks. After the discovery of the liquid in the hose, site personnel sampled the breathing air system at nine different stations to test for air quality and removed and tested the breathing air system filters. They did not find any moisture or ester contaminating the system or the filters. Of the two sequestered hoses, one was found to have only a trace amount of moisture and the hose was dry. Investigators believe the liquid was improperly introduced into the breathing air hose during the ET&I testing process.

Y-12 Site managers are implementing the following corrective actions in response to this event. Like the recognition by the workers that the hoses had not been inspected, these corrective actions are also good practices that may be applied at other DOE sites and facilities using breathing air.

- Y-12 Site ET&I personnel are reviewing their equipment receipt and procurement procedures to ensure that all equipment is properly inspected and tested before it is released for site use. They are also implementing the good practice of modifying their breathing air hose test procedure to require purging the hoses after testing to check for the presence of foreign substances in the hoses.

- Y-12 Site personnel are proceduralizing the good practice of requiring workers to purge breathing air hoses just before using them with respirators to ensure adequate air flow, to rid the hose of trapped, stale air, and to verify there is no foreign substance in the hose.

NFS reported another problem that was experienced with breathing air hoses. Weekly Summary 95-36 reported that maintenance personnel at Rocky Flats were performing final checks of supplied-air respiratory equipment when they discovered deficiencies in four breathing air hoses. One hose completely separated from its crimped fitting and the other three hoses did not meet leak test criteria. Investigation by respiratory protection engineers led to discontinuing the use of certain breathing air hoses at Rocky Flats and highlighted the need for improved control over supplied-air hoses. (ORPS Report RFO--KHLL-PUFAB-1995-0018)

Facility managers and breathing air system supervisors should ensure that their procurement and receipt procedures do not allow breathing air equipment to bypass the inspection and testing processes. Although different departments within a single facility or site may purchase breathing air hoses, the hoses should be sent directly to the responsible testing group rather than to the purchasing organization or person. Equipment should be sent to storage or to a work site only after inspection and testing have been completed. Visible tags or records should accompany breathing air equipment to indicate that this has been done. Workers who use breathing air equipment should ensure that their equipment has been properly inspected and tested and should also perform their own checks on the equipment before using it. Facility personnel should refer to the following information for guidance concerning the use of breathing air.

- 10 CFR 1910.134, *Respiratory Protection*, requires compressed breathing air to meet at least the requirements for Grade D breathing air as described in ANSI/Compressed Gas Association (CGA) Specification for Air, G-7.1-1989. These specifications include an oxygen content between 19.5 and 23.5 percent, a condensed hydrocarbon content of no more than 5 mg/m^3 of air, a CO content of 10 ppm or less, a CO_2 content of 1,000 ppm or less, and no noticeable odor.

- DOE/EH-0256T, *Radiological Control Manual*, paragraph 531, cites DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards*, which mandates that breathing air meet the specifications of ANSI/CGA G-7.1 Grade D breathing air as specified in 20 CFR 1910.134. The manual also requires that compressed air supplied to respirators shall be tested quarterly and that breathing air compressors shall not allow oil or other chemicals and fumes to enter the breathing air supply.

- National Institute of Occupational Health (NIOSH) publication 87-116, *NIOSH Guide to Industrial Respiratory Protection*, is a complete reference to respirators and breathing air and includes sections that cover the types, selection, and use of respirators. Appendix F to this publication is a comprehensive guide to breathing air systems and discusses breathing air system performance requirements, the types of breathing air systems, and cautions in the use of breathing air systems. It can be viewed at http://www.cdc.gov/niosh/87-116.html.

KEYWORDS: breathing air, contamination, good practices, industrial hygiene, respirator

FUNCTIONAL AREAS: Industrial Safety, Procurement

2. NEAR MISSES DURING ENERGIZED ELECTRICAL EQUIPMENT DIAGNOSTICS

On May 11, 1999, at the Thomas Jefferson National Accelerator Facility (Jefferson Lab), a subcontractor heating, ventilation, and air conditioning (HVAC) technician diagnosing a high building temperature caused a direct short to ground within the electrical compartment of an outdoor HVAC unit. The technician opened the hinged outer door to the electrical compartment and unfastened the cover to an inner compartment when a sudden wind gust forced the outer door closed and pushed his arm and the inner compartment cover towards and into the electrical compartment, causing the short. Although there was no injury, the technician's failure to use personal protective equipment and to follow Jefferson Lab and DOE electrical safety procedures could have caused him injury or even death. (ORPS Report ORO--SURA-CEBAF-1999-0001)

One corner of the inner cover contacted the high-voltage 277 V ac primary-side terminals of a control circuit transformer while the opposite corner contacted the metal compartment enclosure. This provided a direct short through the metal cover and the unit's frame to ground. The technician observed and heard an electrical arc when the inner cover entered the electrical compartment but was not injured and did not receive an electrical shock. Damage to the HVAC unit was only cosmetic and was limited to the inner compartment cover and the transformer terminal. The electrical short caused the unit's dedicated breaker to trip and also tripped the feeder breaker to the switchboard that supplies the HVAC unit, which caused a power loss to one sector of the accelerator area.

Investigators determined that the technician did not have an approved work plan for troubleshooting the HVAC unit. They also determined that he was not using any personal protective equipment for working on energized electrical equipment. The Jefferson Lab EH&S manual requires at least two qualified persons to be present for the type of work on energized electrical equipment the technician was performing, as well as formal approval and general supervision. The manual states that service work performed on energized ac electrical power equipment requires the development of an approved Standard Operating Procedure, which includes the performance of a hazard analysis. Such an analysis specifies the personal protective equipment to be worn for the work. Corrective actions identified to prevent the recurrence of this event include the following.

- Maintenance personnel fitted the inner cover of the HVAC unit with a hinge and made provisions to secure both the inner and outer compartment doors in the open position during diagnostics and troubleshooting.

- The Jefferson Lab Plant Engineering Department is examining all other HVAC units and will retrofit them with hinged doors and with the hardware to secure the doors in the open position.

- The Plant Engineering Department restated to the HVAC subcontractor's staff the conditions under which HVAC and other equipment may be opened for diagnostics while energized, including two-person work rules and the use of personal protective equipment.

OEAF engineers also reviewed another recent event in which safety precautions were not taken during HVAC diagnostics. On May 6, 1999, at the Argonne National Laboratory—East, a staff member having knowledge of and experience with HVAC equipment repair was diagnosing the failure of an HVAC unit to maintain a laboratory's temperature at a comfortable level. The employee removed two access panels to gain access to the unit's electrical circuitry for troubleshooting and used test equipment to diagnose the source of the problem. Investigators determined that the employee did not initiate a hot work permit or implement a lockout of the unit. Corrective actions identified by the Laboratory's managers include (1) reminding the employee

and his supervisor of the requirement for using a lockout/tagout, if possible, or requesting a hot work permit when diagnosing electrical equipment, (2) restating to all Laboratory personnel the importance of following Laboratory requirements when working on electrical systems, and (3) retraining the employee and his supervisor on lockout/tagout requirements and electrical safety. (ORPS Report CH-AA-ANLE-ANLEER-1999-0007)

NFS has reported similar events involving accidents while work is being performed near energized equipment. Some examples follow.

- Weekly Summary 98-50 reported that an electrical engineer at the Rocky Flats Environmental Technology Site Broomfield Warehouse accidentally contacted an inadequately wrapped 480-V cable connection with a clamp-on ammeter, causing an electrical arc and a blown fuse in a power distribution panel. The engineer was measuring current flow in surrounding components when he contacted the cable connection and a metal wireway with the ammeter. Investigators determined that because the warehouse is off-site and is not a DOE facility, no one implemented the necessary work control programs or safety measures. Although the engineer was not injured, no safety measures were in place to protect him from a fatal electrical shock or a severe flash burn. (ORPS Report RFO--KHLL-371OPS-1998-0085)

- Weekly Summary 98-35 reported that a subcontractor electrician at the Rocky Flats Environmental Technology Site Plutonium Processing and Handling Facility observed an electrical arc from a primary-phase winding connection on an energized 480-V, three-phase transformer to a ground-strap while he was working on it. The arc left burn marks on the electrician's protective glasses, but he was not injured. Investigators believe that material the electrician was removing from the area accidentally contacted a ground-wire lug, causing the arc. (ORPS Report RFO--KHLL-371OPS-1998-0065)

- Weekly Summary 98-29 reported that an electrician at the Hanford Site N-Reactor observed an electrical arc and fireball while disconnecting circuit leads from a 480-V motor control center. The fireball occurred when a bare ground-wire came in contact with the exposed, energized feeder bus in the motor control center. (ORPS Report RL--BHI-NREACTOR-1998-0020)

- Weekly Summaries 98-23 and 97-44 reported that two subcontractor electrical workers at Fermi National Accelerator Laboratory received flash burns from an electrical arc when a metal cover contacted an energized bus bar as they attempted to connect a cable for a temporary feed from a 480-V motor control center. A Type B accident investigation team identified the following root causes for the event: (1) the electricians did not understand that there were energized components behind the bus bar cover and (2) the Laboratory failed to ensure that an integrated safety management system was implemented for electrical work. (*Type B Accident Investigation Board Report on the October 22, 1997, Electrical Arc Blast at Building F-Zero, Fermi National Accelerator Laboratory, Batavia, Illinois*, November 1997; and ORPS Report CH-BA-FNAL-FERMILAB-1997-000 4)

These events underscore the importance of an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analyses must be included in the work control process to help prevent worker injury. The hazard analysis process should include provisions for lockouts/tagouts, job-specific walk-downs, integration of work activities, and personal protective equipment. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with high-voltage electrical activities.

Facility managers, work planners, and crafts personnel should review the following references, which provide guidance and good practices for planning electrical work.

- 29 CFR 1910, subpart S, "Electrical," describes work practices to be employed to prevent injuries when work is performed near or on equipment or circuits that are, or may be, energized. 29 CFR 1910.333, *Selection and Use of Work Practices*, states that when any employee is exposed to contact with parts of fixed electric equipment or circuits that have been de-energized, the circuits energizing the parts shall be locked out or tagged out. It also states that “Only qualified persons may work on electric circuit parts or equipment that have not been deenergized…” and that “Such persons shall be capable of working safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.”

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* provides guidance on the implementation of effective lockout/tagout programs. The order states that the primary purpose of a lockout/tagout program is to protect personnel from injury and protect equipment from damage.

- DOE/ID-10600, *Electrical Safety Guidelines*, prescribes electrical safety standards for DOE field offices and facilities. It includes information on work practices, protective equipment, insulated tools, and recognition of electrical hazards. Section 2.1.2 states “Work that is performed on energized electrical systems and equipment may only be done if a supervisor, or cognizant safety professional, and the personnel performing the work determine that the work can be done safely. Approval must be given for each job.”

- DOE-HDBK-1092-98, *Electrical Safety*, contains explanatory material in support of OSHA regulations and nationally recognized electrical safety standards. It provides safety-related work practices to prevent electrical shock or electrically induced injuries when employees work on or near electrical conductors or circuit parts that are energized. It can be found at http://www.doe.gov/html/techstds/standard/ standard.html.

Integrated safety management information can be found at http://tis-nt.eh.doe.gov/ism and OSHA regulations are at http://www.osha-slc.gov/OshStd_toc/ OSHA_Std_toc.html.

KEYWORDS: electrical safety, hazard analysis, near miss, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Hazards and Barrier Analysis, Work Planning, Industrial Safety

3. CONCERNS ABOUT A COMMON MODE FAILURE FOR MAGNE-BLAST BREAKERS

On May 5, 1999, the licensee of a commercial nuclear power plant reported a 10 CFR Part 21 notification to the Nuclear Regulatory Commission (NRC) regarding problems with General Electric 7.2-kV Magne-Blast circuit breakers that failed to close because of mechanical interference. The licensee reported the problem to the NRC because it wanted to call attention to a substantial safety hazard posed by the circuit breakers, which support the plant emergency diesel generators and safety-related equipment. (NRC Event No. 35677)

Plant engineers investigated and tested the failure of the circuit breakers to close. They found that a cotter pin was striking the latch check switch mounting bracket and bending it forward. This action removes the factory set clearance between the bracket and the switch actuating paddle, which in turn causes the paddle, bolted to the trip shaft, to roll the trip shaft to the trip position when the breaker attempts to close. The cotter pin problem is considered a defect in repair. It could lead to a common mode failure for safety-related Magne-Blast breakers.

The function of the latch check switch is to enable rapid, repeated closing of the breaker, which is not required in the application for which these breakers are used at the power plant. Plant engineers determined that removing the latch check switch, the latch switch mounting bracket, and the actuating paddle will prevent recurrence of this problem. The licensee has performed this modification on all of the safety-related Magne-Blast breakers.

NFS has also reported breaker closing problems associated with 4-kV Magne-Blast breakers in the Weekly Summary. The breakers were General Electric type AM 4.16-350-2H, 1,200-amp and 2,000-amp frame sizes. The failure symptom is described in NRC Information Notice 95-54, “Failures of General Electric Magne-Blast Circuit Breakers to Latch Closed,” August 1, 1994. The notice stated that breakers susceptible to unreliable latching had single prop springs. Utility engineers working with General Electric engineers discovered that changing the single prop did not correct the problem and that mechanical misalignment contributed to the improper operation of the breaker mechanism. The mechanisms were often twisted relative to the circuit breaker pole unit (frame), causing the prop to hit the prop pin rather than move to a position under the prop pin to latch. Repairs include realignment of the prop. (Weekly Summaries 96-22, 94-35, and 94-05)

Maintenance managers should verify the condition of installed 7.2-kV Magne-Blast circuit breakers. Copies of NRC notices and reports can be obtained from the NRC Public Document Room, (202) 634-3273. They can also be accessed at http://www.nrc.gov/OPA/reports.

KEYWORDS: actuation, circuit breaker, electrical maintenance, operating experience

FUNCTIONAL AREAS: Electrical Maintenance, Operating Experience

4. INJURY DURING VENTING OF HIGH-PRESSURE HELIUM GAS

On May 11, 1999, at the Brookhaven National Laboratory, an operator was injured while venting helium from a cryogenic system that supports the Relativistic Heavy Ion Collider (RHIC). He was opening a manual valve when he accidentally got into the path of the gas exiting the valve. The helium pressure in the system was approximately 230 psig. The force of the venting gas blew the operator approximately 6 ft. He hit a helium gas storage tank across from the valve, thereby sustaining a laceration to the head. An ambulance transported him to a hospital for observation and treatment. He returned to work later that day. Although the operator's injury was minor, venting high-pressure systems to atmosphere can be dangerous because of jet forces, high noise levels, and other properties such as temperature (steam and cryogenic gases). (ORPS Report CH-BH-BNL-BNL-1999-0012)

The RHIC, which is one of the world's largest and most powerful collider accelerators, is in the process of commissioning and startup operations. The cryogenic system is a very large refrigeration unit that provides helium at 4.5 degrees above absolute zero. The helium is used to cool the superconducting magnets in the RHIC. During this startup operation, gas pressure in the cryogenic system was being relieved to reduce pressure below a setpoint for automatic venting. A cryogenic shift supervisor directed the operator to open a manual valve in the helium tank farm. In the process of opening the valve the operator apparently either slipped or applied too much force to the valve, causing his momentum to carry him into the vent path. A second operator in the tank farm called the cryogenic control room on his radio, requesting help. Radio communication was poor because of the high noise level of the venting gas. A third operator, dispatched from the control room, requested an ambulance while the second operator helped the victim away from the scene. Another operator later shut the valve when the gas pressure was reduced. The associate project director for the collider appointed an investigation committee and directed that a supervisor must be present when any manual vent valves are operated, at least until the investigation is complete. Figure 4-1 shows the helium tank farm where the operator was working and figure 4-2 shows the compressor building, the refrigerator building, and the control building (in the background).

Figure 4-1. Helium Tank Farm

Figure 4-2. Relativistic Heavy Ion Collider Buildings

The manual valve, which is a 3-in. ball valve intended as a future connection for additional helium storage tanks, had not been operated in years. It is located outside at the helium tank farm. The valve is connected to a 3-in. pipe header by a 6-in. section of pipe; a pressure gauge is installed upstream of the valve. The exit side of the valve is normally blank-flanged when it is not used. The valve is 50 in. above the ground and vents horizontally. This places it chest-high for most operators.

Investigators determined that the ball valve did not have a handle (valve operator). The operator first used a wrench and was able to crack open the valve using much force. He then closed the valve, adjusted his ear protection, and added an extension to the wrench for more leverage. There was no pipe extension to direct the venting gas away from the operator and there was no muffler for noise control. Engineers selected this valve because it would provide the best available flow rate. A ball valve restricts flow only slightly, but it will travel from full close to full open with only 90 degrees of movement on the part of the valve operator. Investigators also determined that the venting operation was performed under the guidance of engineering control and skill-of-the-craft. There was no specific procedure to vent the system in this manner. Two operators are required for safety by procedure and by the accelerator safety envelope for cryogenic fieldwork.

This event illustrates the danger associated with venting high-pressure systems and the need to exercise caution near the vent or relief path while venting is in progress. Jet forces can inflict injury directly or by creating a missile. High or low temperatures associated with the vented liquid, gas, or steam can also cause injuries. Engineered barriers are effective in protecting personnel from these hazards. Personnel also need to be concerned with the high noise levels that are produced. If a muffler is not installed, hearing protection must be provided and used. Sounds above 120 db can cause hearing damage after only a brief exposure. A jet engine produces 140 db.

This event also underscores the importance of identifying hazards in the workplace and protecting the workers from these hazards. This is particularly important during the startup and testing of new facilities and equipment, when most evolutions are performed for the first time, operating experience may be limited, and procedures may not be formalized.

DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, states that the contractor must identify workplace hazards and evaluate the risk of associated worker injury or illness. The *Hazard and Barrier Analysis Guide*, developed by OEAF, includes a hazard-barrier matrix showing that physical barriers are among the most effective types of barriers against pressure and motion sources.

KEYWORDS: accelerator, gas, injury, operations, vent

FUNCTIONAL AREAS: Hazards and Barrier Analysis, Operations

FINAL REPORT

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. INADEQUATE WORK PLANNING RESULTS IN ELECTRICAL NEAR MISS

On March 8, 1999, at the Hanford Site, two Bechtel Hanford electricians discovered an unexpected energized 120-V ac control circuit inside a 480-V ac local control panel they thought was de-energized. The electricians, who were performing maintenance on a building exhaust fan, had misinterpreted a step in the applicable work package and were preparing to inspect the fan's local control panel instead of the exhaust fan motor, electrical boxes, and connections. They immediately stopped work on the panel and notified appropriate personnel. Undetected energized circuits pose electrical shock hazards to workers that may result in serious injury or death. (ORPS Report RL-BHI-DND-1999-0002)

The electricians were tasked with isolating 480-V ac electrical power to the building's west exhaust fan in preparation for maintenance activities that included visual inspection and lubrication of the fan motor. The west and east fans supply negative pressure ventilation to the building, and one fan must be operating at all times. A supervisory field engineer conducted a pre-job briefing with the two electricians to discuss the scope of work and to perform a system walk-down. The electricians were preparing for work on the west fan motor first and opened its 480-V ac main panel supply breaker. They successfully checked the load side of the 480-V ac control panel disconnect and the line side of the contactor for zero energy. They then applied a lockout/tagout to the 480-V ac main panel supply breaker. At this time, the west exhaust fan was not running, the east exhaust fan was operating, and the west fan's local control panel was thought to be completely de-energized.

A procedure step in the maintenance work request instructed workers to check electrical boxes and conduit for weather tightness, visible damage, and loose connections. The field engineer and electricians misinterpreted this step to include the interior of the west exhaust fan local control panel. As part of this check, one of the electricians manually actuated a contactor mechanism inside the local control panel, whereupon the east fan, which had been running, began slowing down. The field engineer immediately restarted the east fan before all ventilation air flow was lost. One of the electricians connected a voltmeter to the contactor and detected 120-V ac from an unknown source. The electricians stopped work on the panel, restored the system, and made appropriate notifications. They subsequently learned that the two exhaust fan motors share contacts inside the local control panel as part of an interlock control circuit. This interlock prevents starting one fan if the other is already running. The electrician inadvertently initiated the interlock and interrupted power to the operating fan when he manually inserted the contactor.

Investigators determined the direct cause of this near miss to be personnel error (inattention to detail) and the root cause to be procedure problem (defective or inadequate procedure). The wording of one step in the work package led the field engineer and electricians to believe connections in the exhaust fan motor local control panel had to be checked for tightness. The intended scope of the work package was to inspect, clean, and lubricate the motor and fan. Investigators also identified the following contributing causes.

- Neither the panel nor the contactor had been labeled to indicate the presence of 120-V ac control power inside the panel.

- The work package review was inadequate. The intended scope of work was to lubricate and inspect the fan and motor. Since it was not anticipated that the local control panel would be entered to perform the intended work scope, planners did not include electrical circuit or wiring diagrams in the package. Also, the work package contained no instructions for de-energizing control power and no energized work permit. The field engineer and electricians should have noticed this and questioned the need to enter and inspect the local control panel.

- The field engineer and electricians did not perform a zero-energy check on all terminals inside the local control panel before beginning the internal inspection. They performed only a partial check for zero energy after opening, locking, and tagging the main supply breaker.

Bechtel Hanford personnel identified several lessons to be learned from this event. Planners should write work instructions clearly and concisely to ensure that maintenance personnel do not work outside the intended scope of work and inadvertently encounter unplanned hazards. Workers performing work inside electrical panels must use all necessary and available means (such as prints, diagrams, lockouts/tagouts, and thorough energy checks) to ensure that equipment is de-energized. Managers, supervisors, and work planners must determine any alternative power sources to equipment, label the associated equipment, and identify them in work package instructions.

Bechtel Hanford personnel prepared the following corrective actions in response to this event.

- Revise the work package to clarify the scope of work such that a mechanical integrity check of connections and components inside the exhaust fan local control panel is not required.

- Conduct walk-downs and inspections of the electrical panels associated with the exhaust fans to determine alternative sources of power and apply the appropriate labels.

- Insert a warning in the work package instructions identifying the existence of alternative power sources inside the local control panels.

- Review all open building maintenance work packages to determine if similar step clarifications and hazard warnings are needed.

- Review the results of the event critique with all field engineers and electricians.

- Issue policy guidance on the use of wiring diagrams and electrical prints in work packages.

- Prepare lessons learned and incorporate them into the Lessons Learned Program.

This event underscores the importance of using detailed job planning and effective work control practices to provide multiple levels of protection against safety hazards. Work packages must clearly identify all potential safety hazards and contain clear and concise work instructions. Planners should include up-to-date wiring diagrams and electrical drawings in the work packages and workers should expect to see and use them. Workers should stop work and consult with their supervisor or work planner if there is any doubt about the work instructions or work scope. Workers should perform thorough and complete zero-energy checks as the final barrier against electrical shock.

KEYWORDS: electrical maintenance, electrical safety, labeling, planning, work planning,

FUNCTIONAL AREAS: Electrical Maintenance, Work Planning

PRICE-ANDERSON AMENDMENTS ACT (PAAA) INFORMATION

1. PRELIMINARY NOTICE OF VIOLATION AND PROPOSED CIVIL PENALTY FOR RADIOLOGICAL CONTROL DEFICIENCIES

On April 15, 1999, the DOE Office of Enforcement and Investigation issued a Preliminary Notice of Violation to Brookhaven Science Associates (BSA) and proposed a $27,500 civil penalty under the Price-Anderson Amendments Act for deficiencies in BSA's radiological protection and work process control programs. The Office of Enforcement and Investigation conducted the investigation and determined that a series of failures occurred from March through June 1998 in which BSA personnel failed to comply with nuclear safety requirements. These potential violations occurred at the Brookhaven National Laboratory's high flux beam reactor (HFBR), the alternating gradient synchrotron (AGS), and the radiation therapy facility (RTF) operated by Stony Brook University Hospital (SBUH). Investigators stated that although these violations did not result in any unnecessary exposures, there was a potential for unnecessary exposures. Investigators determined that in some cases the deficiencies reflected broader programmatic implications that were not recognized by BSA managers until an independent investigation was completed by BSA's Independent Oversight Office. Investigators stated in the Notice that they are concerned about the RTF potential violations because BSA did not ensure that SBUH personnel were adhering to BSA's established safety requirements. Investigators elected to defer enforcement actions against SBUH but stated that any further violations may result in an enforcement action. (NTS-CH-BH-BNL-BNL-1998-0004; Letter, DOE (D. Michaels) to Brookhaven Science Associates (J. Marburger), 04/15/99)

DOE identified multiple deficiencies and classified them as Severity Level II violations and as a Severity Level III violation in the Preliminary Notice of Violation. Severity Level II violations are significant violations that demonstrate a lack of attention or carelessness toward safety that could potentially lead to adverse impacts. Severity Level III violations are characterized as less serious violations that if left uncorrected, could lead to more serious safety concerns. Investigators determined that these deficiencies represent potential violations of 10 CFR 830.120, *Quality Assurance Rule*, and 10 CFR 835, *Occupational Radiation Protection*. The notice describes violations that involved (1) apparent intentional radiation protection requirement violations at the HFBR, (2) failure to maintain proper access controls at the AGS accelerator, and (3) the bypassing of a safety interlock during operation of a linear electron accelerator at the RTF.

HFBR RADIATION PROTECTION VIOLATIONS

Investigators determined that work control violations occurred while operators were performing work on the HFBR fuel test loop system. They determined that a reactor operator consciously ignored established radiation protection requirements when he removed potentially contaminated equipment from a controlled area. They determined that he did not adhere to either the protective clothing requirements or the requirement to notify radiation protection personnel before entering the controlled area. In addition, the operator did not comply when he was issued two separate stop-work instructions. Investigators reduced BSA's proposed civil penalty to $27,500 (a 50 percent mitigation) because BSA had assumed operational responsibility shortly before this event occurred and because DOE investigators have observed improvements in Brookhaven National Laboratories management since the violation occurred. However, they determined full mitigation was not warranted because of the intentional nature of the violation and because broader site-wide corrective actions have not been fully implemented. DOE aggregated the following three violations under one citation.

- A reactor operator (1) violated radiological area posting requirements when he accessed a radiological area and removed a bucket, (2) failed to use a radiological work permit when he removed the bucket, and (3) failed to notify health physics personnel before he entered the radiological area.

- A reactor operator failed to wear required protective clothing when he entered the radiological area and removed a bucket from the decontamination sink.

- A reactor operator did not adhere to two separate stop-work instructions issued by a health physics technician. The technician saw the operator enter the posted radiological area without following the posted radiation control barrier requirements.

AGS ACCESS CONTROL VIOLATIONS

Investigators identified that administrative controls and procedural requirements were not used to maintain radiation exposures as low as reasonably achievable (ALARA) when three of six levels of access control failed, causing a worker to be left inside the AGS ring. Investigators stated in the notice that this was "of significant regulatory concern because the AGS becomes a high radiation area during AGS operation." They also stated that "AGS personnel did not exhibit an understanding and appreciation of the importance of AGS entry control measures that were in place, and further, the AGS team appointed to perform an internal review of the event very narrowly limited the scope of their review." DOE identified three Severity Level II problems. They would normally have proposed a collective civil penalty totaling $55,000 and reduced it by 50 percent, but the Atomic Energy Act of 1954 does not provide for civil penalties for violations that involve accelerator-produced radiation.

- Operations personnel mistakenly declared that all personnel were accounted for during an access control personnel check and reset the AGS ring to a “beam enabled” status. In fact, one technician was inside the ring when operators reset it.

- A worker signed out on the AGS ring security log in the wrong space, realized his mistake, and obscured his sign-out by an improper log entry. This action contributed to the gate watch’s incorrect assumption that all persons were accounted for when he performed the access control personnel check.

- No one performed a timely sweep of the AGS ring before it was reset, which was one reason the technician was inside after operators reset it. Procedures require that personnel perform a cursory sweep when more than 25 personnel entries are made or when the gate is open for more than 4 hours.

RTF ACCELERATOR SAFETY INTERLOCK VIOLATIONS

Investigators identified violations when SBUH personnel bypassed a safety interlock during operation of the linear electron accelerator, which is used to treat cancer patients. Investigators determined that SBUH personnel taped over one of two interlocks to allow the accelerator to continue to operate. They stated that the safety significance of this violation was slight because one interlock still functioned. DOE identified the following three violations as a collective Severity Level III violation.

- Personnel did not control entry to the accelerator room in a manner commensurate with the radiological hazards when they bypassed an interlock by taping it closed. Redundant safety interlocks are required to permit continued accelerator operation.

- Personnel tested the accelerator interlocks semiannually instead of monthly, as required by the safety analysis report.

- No one developed procedures to ensure the effectiveness and operability of the accelerator barricades and locks, as required by the safety analysis report.

BSA managers have replied to the Preliminary Notice of Violation and Proposed Imposition of Civil Penalty and admitted the alleged violations, paid the civil penalty, and submitted to DOE a corrective action plan to prevent recurrence. Enforcement actions can be found at the Office of Enforcement and Investigation website at http://tis-nt.eh.doe.gov/enforce/.

NFS has reported recent Notices of Violations under the Price-Anderson Amendments Act in Weekly Summaries 98-51, 98-49, 98-42, 98-41, 98-40, 98-26, 98-15, and 98-11.

Under the provisions of the Price-Anderson Amendments Act, DOE can fine contractors for violations of Department rules, regulations, and compliance orders relating to nuclear safety requirements. DOE contractors operate nuclear facilities or perform nuclear activities and fail to remain in compliance with such requirements could be subjected to Price-Anderson civil penalties under the work processes and quality improvement provisions of 10 CFR 830.120, *Quality Assurance Requirements,* and/or 10 CFR 835, *Occupational Radiation Protection*. These actions include Notices of Violation and, where appropriate, nonreimbursable civil penalties.

The primary consideration for determining whether DOE takes enforcement action is the actual or potential safety significance of the violation, coupled with how quickly the contractor acts to identify and correct problems. The Office of Enforcement and Investigation may reduce penalties when a DOE contractor promptly identifies a violation, reports it to DOE, and undertakes timely corrective action. DOE has the discretion not to issue a Notice of Violation in certain cases.

The Noncompliance Tracking System (Weekly Summaries 95-17 and 95-20) provides a means for contractors to promptly report potential noncompliances and take advantage of provisions in the enforcement policy. DOE-STD-7501-95, *Development of DOE Lessons Learned Programs*, discusses management responsibility for incorporating appropriate corrective actions in a timely manner.

KEYWORDS: enforcement, Price-Anderson Act, quality assurance, radiation protection, procedures

FUNCTIONAL AREAS: Lessons Learned, Radiation Protection, Operation, Licensing/Compliance